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(54) A security apparatus and a method of operating the security apparatus

(57) A security apparatus 10 comprises a base station 12 with an aerial 20 acting as transmitter and receiver, a control unit 18 and an RFID security tag 14. The aerial sends a monitor signal of limited range which is received by, and preferably powers, the RFID security tag 14. On receipt of the monitor signal, the tag 14 sends an identity signal of limited range. The identity signal is received by the aerial 20 and passes to the control unit 18. Removal of the RFID security tag 14 out of range of one of the signals causes the identity signal not to be passed to the control unit 18 which can sound an alarm. A method of operating such an apparatus also forms part of the invention. In another aspect, the apparatus comprises an aerial 20, an RFID security tag 14 with an identity code, a control unit 18 and a control tag 14 which comprises a security tag which the control unit 18 has been programmed to recognise as a control tag.

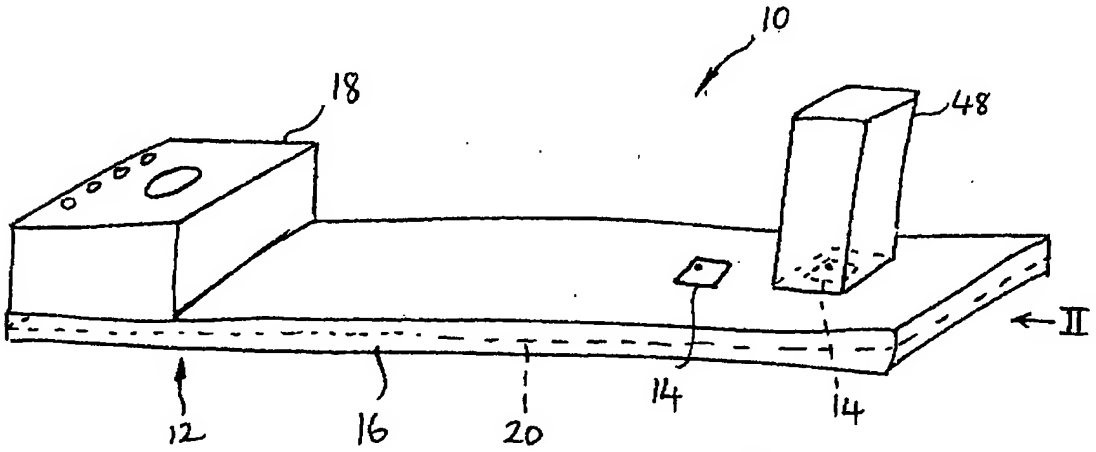

FIG. 1

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Description

[0001] The invention relates to a security apparatus and a method of operating the security apparatus. In particular, although not exclusively limited thereto, it relates to a security apparatus for use in the prevention of theft of items, for example, high value items in a shop.

[0002] Various security devices for prevention of shoplifting are known. Where electrical devices are displayed and those devices have a jack plug socket it is known to provide a security system in which a central control box has a series of leads running from it and the leads terminate in a jack plug whereby, if the jack plug is pulled from the device; for example by someone attempting to steal the electronic device, a circuit is broken and an alarm is sounded. The system commonly used on items of clothing is the use of a magnetic tag which can be sensed by sensors normally placed at the exit of the store. If the magnetic tag is sensed by the sensors then an alarm can be sounded. Normally, of course, the tag is removed by the cashier when the item is purchased. The first system is only appropriate for use on items which have an appropriate socket and the second system has the disadvantage that it is only activated when the potential thief is close to the exit of the store giving a greater chance of escape. Whilst it is appropriate to provide a system which can allow clothing to be moved around a store, for example so that it can be tried on in dressing rooms, such a system is not desirable for portable high value objects, for example small electronic devices, jewellery or works or art. In addition, there are alternative systems provided whereby a microswitch is adhered to the surface of an object and a lead runs from the microswitch to a control box. If the item is removed with sufficient force to pull the microswitch off the item an alarm can be sounded. Those systems have not gained widespread acceptance in certain fields, for example jewellers because of the detrimental effect they have on the aesthetic appeal of the display. In addition, those systems are limited to protect a maximum number of items. In other words, it is only possible to protect the number of items for which microswitches are available. The control box generally has a fixed number of inputs from microswitches which limits the application of the system.

[0003] It is an object of the invention to provide an improved security apparatus and an improved method of operating the security apparatus.

[0004] According to a first aspect of the invention there is provided a security apparatus comprising monitoring means having a first transmitter, a first receiver and a controller, and a security element having a second transmitter, a second receiver and an identity signal generator arranged to generate an identity signal, the first transmitter being arranged to send a monitor signal at a set frequency, the second receiver being arranged to receive the monitor signal and, on receipt of the monitor signal by the second receiver, the second transmitter being arranged to send the identity signal, the first receiver being arranged to receive the identity signal and pass the identity signal to the controller, the transmission of the monitor signal or the identity signal having a limited range whereby movement of the security element away from the monitoring means out of range of the monitor signal or identity signal transmission causes the identity signal for the security element not to be passed to the controller whereupon the controller can initiate an alert condition.

[0005] By the use of remote transmission, the need for multiple wires trailing back to a control box which can become tangled and appear unsightly is eliminated. In addition, the alert is sounded when the absence of an item is detected. Consequently, an alert condition can be initiated much earlier, before the theft is close to an exit of the store.

[0006] Preferably the identity signal transmission has limited range. The effective range is preferably 5-15cm, most preferably 8-10cm.

[0007] The first and second transmitters and receivers are preferably electromagnetic transmitters, most preferably operating in the radio frequency range.

[0008] In a preferred embodiment, the electromagnetic field generated by the first transmitter in transmitting the monitor signal is such that the security element is powered by the energy of the field. That is advantageous in that the security elements do not require their own power supply and as the monitoring means is likely to be powered by the mains there is no possibility of the security element failing through lack of power.

[0009] The security element preferably includes anti-tamper means whereby tampering with the device results in the identity signal not being sent by the second transmitter so as to result in initiation of an alert condition. Most preferably the second receiver is destroyed by tampering.

[0010] Preferably a plurality of security elements are provided, each having respective different identity signals. In such a case the controller preferably initiates an alert if any one of the security elements is moved out of range.

[0011] The security element preferably comprises an RFID tag.

[0012] The alert condition may comprise one or more of the sounding of an audible alarm, the operation of a visible alarm and the initiation of other security measures, for example operation of screens to protect staff and goods, operation of barriers to prevent escape and initiation of close circuit television monitoring of the area concerned.

[0013] A control element may be provided, having a control identity signal. The control element is used to control the security apparatus. In particular, it is used to cancel an alert, once initiated and it is used to start the operation of the device or to restart the operation of the apparatus, once an alert has been cancelled. The control element preferably comprises a security element,

the identity signal of which has been programmed into the controller of a monitoring means as a control identity signal. That programming can be carried out during manufacture, on installation or by the end user of the device. The first transmitter and first receiver preferably comprise an aerial, most preferably a loop of wire connected to a circuit board which carries the electronics for generating the monitoring signal and for the controller. The aerial loop is preferably encased in a rigid material to protect it from damage. The material is preferably a plastics material, most preferably a clear transparent plastics material which may be provided in the form of a shelf on which items to be protected by the security system can be located.

[0014] According to a second aspect of the invention there is provide a method of operating a security apparatus comprising the steps of:

providing a security element having means to generate and transmit over a limited range an identity signal particular to the element, providing a controller having receiving means to receive the identity signal,
arranging the security element so that the receiving means of the controller is within range of the identity signal,
operating the controller to record the presence of the element,
whereby movement of the element away from the receiving means out of range of the identity signal causes the controller to note the absence of the element and to initiate an alert condition.

[0015] The controller preferably comprises a transmitter and the security element a receiver, the method further comprising the steps of sending a monitoring signal from the transmitter in the controller, receiving the monitoring signal in the security element and sending the identity signal from the security clement on receipt of the monitoring signal from the controller. Preferably the step of receiving the monitoring signal in the security element provides power for the security element to send the identity signal.

[0016] A plurality of security elements may be provided, each security element having a respective different identity signal and the step of the controller initiating an alert preferably comprises initiating an alert if the absence of one of the tags is noted.

[0017] A control element may be provided, the control element sending a control identity signal. In such a case, the method further comprises the step of the control element sending a control ID signal to initiate recordal of the presence of the security element. The method may further comprise the step of the control element sending a control identity signal to cancel an alert condition. The control element preferably comprises a security element and the method, in that case, comprises the step of instructing the controller to recognise the identity signal of the particular security element as a control identity signal.

[0018] In accordance with a third aspect of the invention there is provided a security apparatus comprising a monitoring means and a security element having an identity code which includes means to indicate the presence thereof to the monitoring means so as to enable the monitoring means to signal an alert when the absence of the element is determined, the apparatus being controlled by a control element, the control element comprising a said security element whereby the monitoring means is arranged to recognise the identity code of the security element used for the control element as a controller identity signal.

[0019] Preferably the security element comprises an RFID tag.

[0020] The controller may include means to initiate a set-up condition in which a security element sensed by the monitoring means is denoted as a control element.

[0021] According to a fourth aspect of the invention there is provided a method of operating a security apparatus comprising the steps of providing and monitoring means, providing a security element having an identity code which includes means to indicate the presence thereof to the monitoring means so as to enable the monitoring means to signal and alert when the absence of the security element is determined. Providing a control element by operating the monitoring means to recognise a said security element sensed by the monitoring means as a control element.

[0022] A security apparatus and a method of operating the security apparatus in accordance with the above aspect of the invention will now be described in detail by way of example and with reference to the accompanying drawings, in which:

Fig.1 is a perspective view of a security apparatus in accordance with the first and third aspects of the invention,
Figs.2a and 2b are end elevations of the apparatus of Fig.1 looking in the direction of arrow II in Fig.1, and
Fig.3 is a schematic diagram of the electronics in the controller of the apparatus of Figs.1 and 2.

[0023] In Fig.1, a security apparatus 10 comprises a base station generally indicated at 12 and security tags 14. The base station 12 comprises an elongate shelf 16 of transparent plastics material and a central control unit 18.

[0024] The shelf 16 encases a loop of wire 20 (shown in broken lines in Fig.1) which constitutes an aerial. The aerial 20 acts as both transmitter and receiver and constitutes the aforesaid "first transmitter" and "first receiver".

[0025] The central control unit 18, as illustrated schematically in Fig.3 comprises a power supply 22, a transmission section 24, a receiving section 26, a microcon-

troller 28, visual indicators in the form of LED's 30 and an audible alarm 32. The transmission section comprises an oscillator 34 for generating the aforesaid monitoring system, an amplifier 36 and tuning/filtering equipment 38.

[0026] The receiving section 26 comprises a modulation detector 40, an amplifier and filter 42 and a comparator 44.

[0027] The security tag 14 comprises an RFID tag. The term "RFID" is understood to indicate an integrated circuit which generates a radio frequency identity signal. The RFID tag used in the present invention is passive, in other words its power is supplied inductively by receiving energy from a radio frequency electromagnetic field generated in this case by the aerial 20. A tag includes a small aerial for transmitting its identity signal which constitutes a distinctive code programmed into a tag during or after manufacture.

[0028] In use, the oscillator 34 in transmission section 24 of the control unit 18 generates a monitoring signal. That signal is amplified in amplifier 36 and tuned and filter by the tuning and filtering equipment 38 before being passed to the aerial 20 for transmission. The aerial 20 generates a radio frequency field 46 shown in broken lines in Figs.2a and 2b. The RFID tags 14 lying on the shelf 16 fall within the field 46 and are energised by the field so as to modulate their own small aerials with their respective distinctive identity signals. Each of the modulating identity signals is transmitted by the RFID tag 14, The or each identity signal is received by the aerial 20 and is detected by a modulation detector 40 in the receiving section 26 of the control unit 18. The detected signal is passed via an amplifier and filter 42 through a comparator 44 to the microcontroller 28. The microcontroller 28 processes the signal and determines the presence of each tag according to its own unique identity code. As shown in Fig.1, the tag 14 can be attached an item of produce 48 and while the RFID 14 remains within the field 46, the microcontroller 28 in the control unit 18 senses the presence of that tag. If the item of produce 48 is removed from the field 46 so that the RFID tag 14 falls outside the effective range of that field 46, the microcontroller notes the absence of the previously sensed RFID tag and the microcontroller can initiate an alert condition. That alert condition in the present case involves the sounding of an audible alarm 32 although any of the aforementioned measures mentioned in relation to the alert condition may be initiated by the microcontroller 28.

[0029] The security apparatus 10 may be controlled from a remote control station. Alternatively, in the preferred embodiment the controller is controlled by a control RFID tag. The identity of the RFID tag used to control the system may be programmed into the microcontroller during manufacture. Alternatively, the security apparatus 10 can be programmed with the ID of any RFID tag either by an installer or by the end user. The identification of a RFID as the control RFID tag is carried out during the set up phase for the apparatus. When the apparatus is installed the installer can initiate using a command on the microcontroller, a set up phase. An RFID tag which is to be used as a control tag is placed within the RF field 46 so that its ID signal can be transmitted to the microcontroller for storage. The microcontroller senses the control RFID tag and signals confirmation of that ID signal being stored in its memory as the control ID. Multiple control RFID tags can be programmed that way if desired. Once the microcontroller has recorded the control RFID tag, the user can then initiate the normal operation of the security apparatus 10. Under normal operation, the control RFID tag is placed in the field to initiate a "dormant" phase. During that phase, the alarm is disabled and tags 14 can be placed in or removed from the RF field as appropriate. Removal of the control tag 14 from the RF field initiates a "learn" phase. In the learn phase, the oscillator generates the monitoring signal which is transmitted via aerial 20 and any RFID tags which fall within the field 46 transmit their identity back to the central control unit 18. The control unit 18 indicates via the LED indicator 30 the number of RFID tags 14 sensed. Once the user has confirmed that all of the RFID tags within the field 46 have been recognised and confirmed by the controller, the system is then active. Such an arrangement is shown in Figs., 2a and 2b. Fig.1 illustrates the apparatus 10 in the "dormant" phase. The RFID tag 14 which is not attached to the base of an item produce 48 constitutes the control RFID tag. During the dormant phase the article 48 can be removed, or replaced without an alarm. Removal of the control tag initiating the "learn" phase. The system learns the ID of RFID tag 14 on the item of produce 48 and it then enters the active condition shown in Fig.1 and 2. The monitoring signal is transmitted by the aerial 20 to generate the RF field 46 and the RFID tag 14 attached to the item of produce 48 returns its ID signal. Removing the item of produce 48 from the field 46 causes the failure of the ID signal to be transmitted back to the microcontroller 28. The microcontroller 28 thus senses the absence of RFID tag 14 and enters an alert condition. In the present case the alert condition constitutes sounding the audible alarm 32 and, optionally, flashing the LED indicator corresponding to the particular RFID tag 14 that has been removed from the field. It will be appreciated that multiple items of produce can be protected in this way since the system learns what it has to protect in the learn phase. Consequently, it provides a flexible system whereby items can be removed from the shelf when the control tag 14 is present without initiating the alarm and the system then relearns the new configuration of items that it is charged with protecting. Equally, by placing the control tag 14 within the field 46, the learn phase can be reinitiated and further objects can be added within the field 46, each having an individual RFID tag attached thereto. Removable of the control tag 14 causes the microcontroller to learn the ID signals of the new RFID chips within the field 46 and an

increased number of products can thus be protected.

[0030] The RFID chips used in the present system may be purchased from any specialist electronic manufacturer, for example Philips or Texas Instruments. Although a passive RFID tag has been described in relation to the present embodiment it is envisaged that active RFID tags, in other words self-powered RFID tags could be used.

[0031] Although the indicators 30 of the microcontroller 28 have been represented as LED indicators, a numeric display, for example a LCD or LED display may be provided instead. That would allow increased numbers of objects to be protected by the security system.

[0032] The present system provides a flexible security system for the protection of high value readily portable items, especially those items which are required to be displayed aesthetically. The use of the radio tag eliminates the need for hard wire connection to a control apparatus and the use of the RFID chip having a unique identity signal allows multiple items to be protected without a defined limit on the maximum number of items protectable. The use of a passive RFID tag has the advantage that the tags power is provided remotely and is not reliant on its own power source. That in turn means that it is unlikely to lose power erroneously and in addition the tag can be made smaller as a consequence of that.

Claims

1. A security apparatus comprising monitoring means having a first transmitter, a first receiver and a controller, and a security element having a second transmitter, a second receiver and an identity signal generator arranged to generate an identity signal, the first transmitter being arranged to send a monitor signal at a set frequency, the second receiver being arranged to receive the monitor signal and, on receipt of the monitor signal by the second receiver, the second transmitter being arranged to send the identity signal, the first receiver being arranged to receive the identity signal and pass the identity signal to the controller, the transmission of the monitor signal or the identity signal having a limited range whereby movement of the security element away from the monitoring means out of range of the monitor signal or identity signal transmission causes the identity signal for the security element not to be passed to the controller whereupon the controller can initiate an alert condition.

2. A security apparatus according to claim 1 in which the identity signal transmission has limited effective range.

3. A security apparatus according to claim 2 in which the effective range is 5-15cm, preferably 8-10cm.

4. A security apparatus according to any preceding claim in which the first and second transmitters and receivers are electromagnetic transmitters.

5. A security apparatus according to claim 4 in which the electromagnetic field generated by the first transmitter in transmitting the monitor signal is such that the security element is powered by the energy of the field.

6. A security apparatus according to any preceding claim in which the security element includes anti-tamper means whereby tampering with the device results in the identity signal not being sent by the second transmitter so as to result in initiation of an alert condition.

7. A security apparatus according to claim 6 in which the second receiver is destroyed by tampering.

8. A security apparatus according to any preceding claim in which a plurality of security elements are provided, each having respective different identity signals.

9. A security apparatus according to claim 8 in which the controller initiates an alert if any one of the security elements is moved out of range.

10. A security apparatus according to any preceding claim in which the security element comprises an RFID tag.

11. A security apparatus according to any preceding claim in which the alert condition comprises one or more of the sounding of an audible alarm, the operation of a visible alarm and the initiation of other security measures, for example operation of screens to protect staff and goods, operation of barriers to prevent escape and initiation of close circuit television monitoring of the area concerned.

12. A security apparatus according to any preceding claim in which a control element is provided, having a control identity signal.

13. A security apparatus according to claim 12 in which the control element comprises a security element, the identity signal of which has been programmed into the controller of a monitoring means as a control identity signal.

14. A security apparatus according to any preceding claim in which the first transmitter and first receiver comprise an aerial.

15. A security apparatus according to claim 14 in which the aerial comprises a loop of wire connected to a

circuit board which carries the electronics for generating the monitoring signal and for the controller.

16. A security apparatus according to claim 15 in which the aerial loop is encased in a rigid material to protect it from damage.

17. A method of operating a security apparatus comprising the steps of:

providing a security element having means to generate and transmit over a limited range an identity signal particular to the element, providing a controller having receiving means to receive the identity signal,
arranging the security element so that the receiving means of the controller is within range of the identity signal,
operating the controller to record the presence of the element,
whereby movement of the element away from the receiving means out of range of the identity signal causes the controller to note the absence of the element and to initiate an alert condition.

18. A method of operating a security apparatus according to claim 17 in which the controller comprises a transmitter and the security element a receiver, the method further comprising the steps of sending a monitoring signal from the transmitter in the controller, receiving the monitoring signal in the security element and sending the identity signal from the security element on receipt of the monitoring signal from the controller.

19. A method of operating a security apparatus according claim 18 in which the step of receiving the monitoring signal in the security element provides power for the security element to send the identity signal.

20. A method of operating a security apparatus according claims 17, 18 or 19 in which a plurality of security elements are provided, each security element having a respective different identity signal and the step of the controller initiating an alert comprises initiating an alert if the absence of one of the tags is noted.

21. A method of operating a security apparatus according to any of claims 17 to 20 in which a control element is provided, the control element sending a control identity signal, the method further comprising the step of the control element sending a control ID signal to initiate recordal of the presence of the security element.

22. A method of operating a security apparatus according to claim 21 in which the method further comprises the step of the control element sending a control identity signal to cancel an alert condition -

23. A method of operating a security apparatus according claim 21 or 22 in which the control element comprises a security element and the method comprises the step of instructing the controller to recognise the identity signal of the particular security element as a control identity signal.

24. A security apparatus comprising a monitoring means and a security element having an identity code which includes means to indicate the presence thereof to the monitoring means so as to enable the monitoring means to signal an alert when the absence of the element is determined, the apparatus being controlled by a control element, the control element comprising a said security element whereby the monitoring means is arranged to recognise the identity code of the security element used for the control element as a controller identity signal.

25. A security apparatus according to claim 24 in which the controller includes means to initiate a set-up condition in which a security element sensed by the monitoring means is denoted as a control element.

26. A method of operating a security apparatus comprising the steps of providing and monitoring means, providing a security element having an identity code which includes means to indicate the presence thereof to the monitoring means so as to enable the monitoring means to signal and alert when the absence of the security element is determined. Providing a control element by operating the monitoring means to recognise a said security element sensed by the monitoring means as a control element.

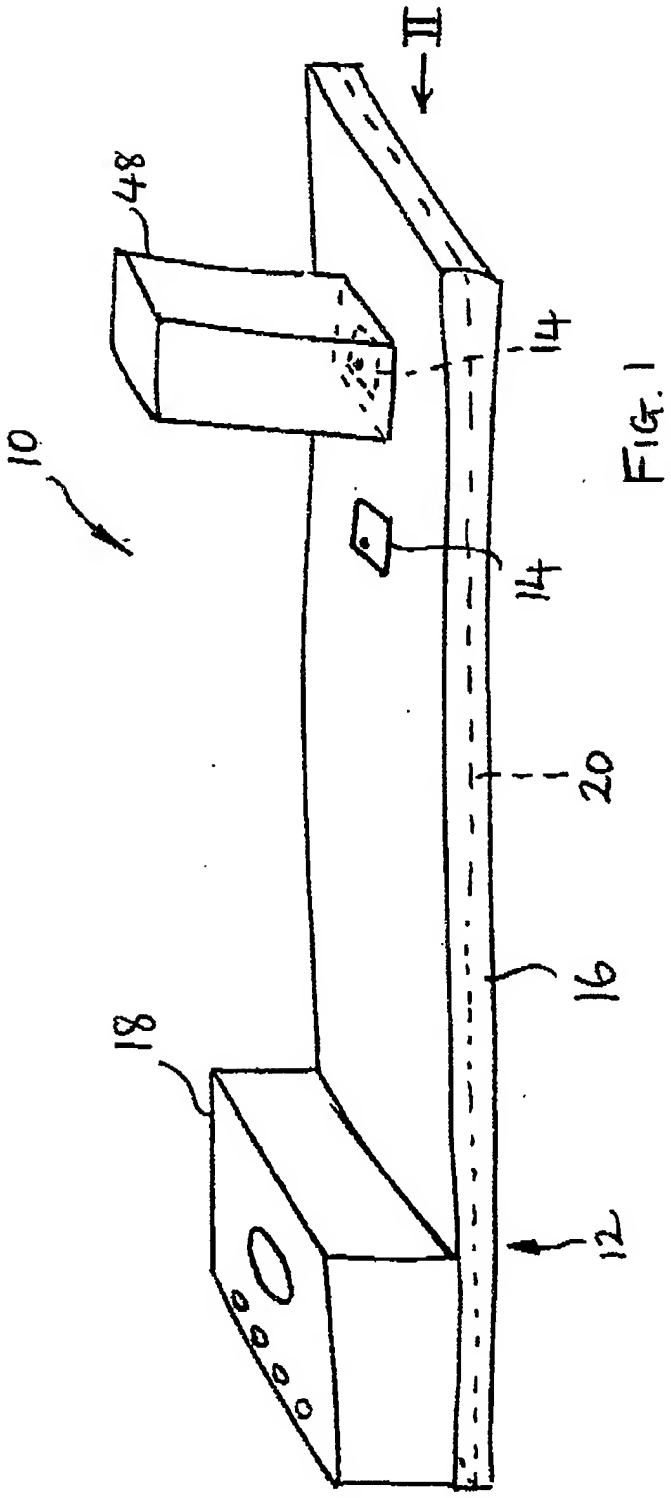

FIG. 1

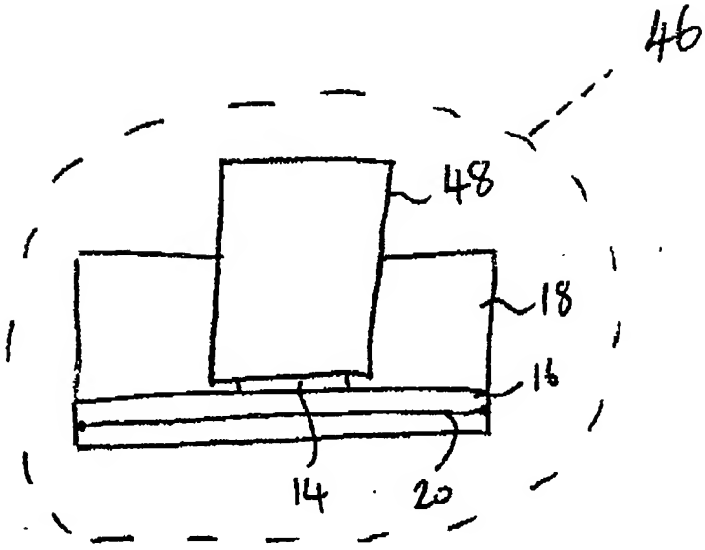

Fig. 2a

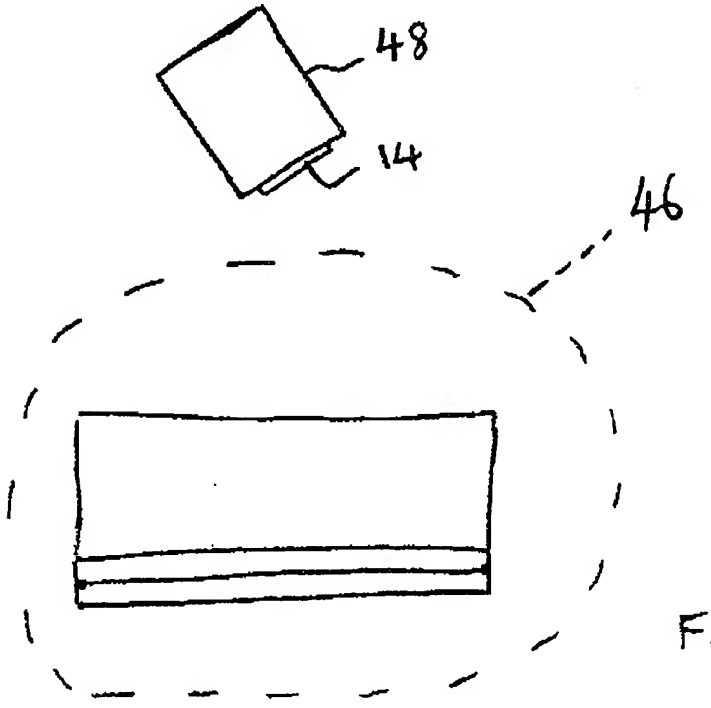

Fig. 2b

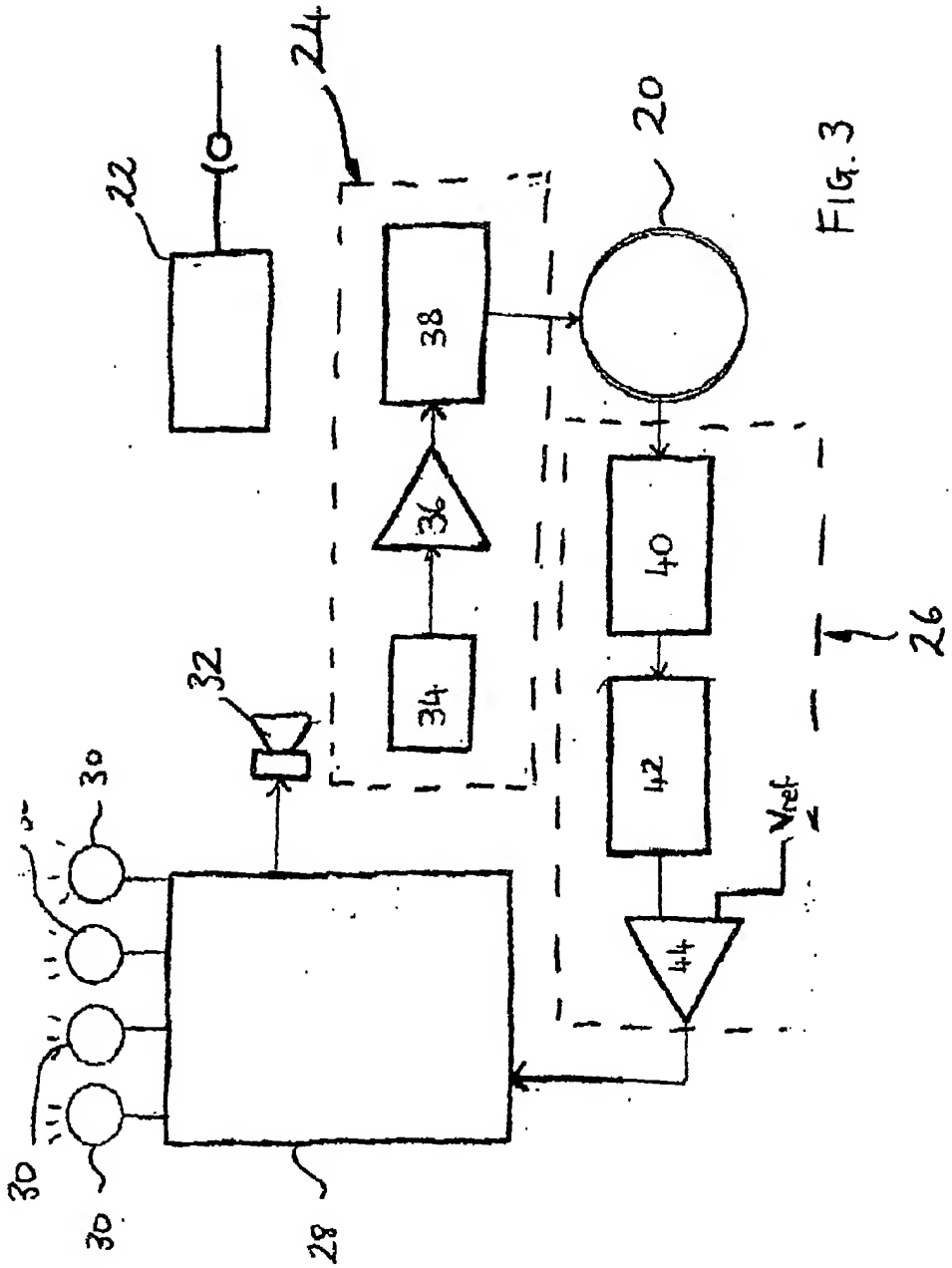

FIG. 3